NEW TECHNIQUES FOR ANALYZING TIME SERIES AND THEIR IMPORTANCE FOR THE CEOS PROGRAM

First International CEOS Meeting, Sept. 1994

Roy Mendelssohn
PFEG
Monterey, CA
USA

Marie-Hélène Durand
ORSTOM
Paris, FRANCE

UNDERSTANDING CLIMATE CHANGE AND FISHERY DYNAMIC

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- Understand How the Environment Affects Fish Dynamics
- Understand What Changes the Climate is Undergoing or is Likely to Undergo
- Combine the Above to Present Scenarios for the Future
- Techniques to be Discussed Mainly Aimed At Second Question

WHAT IS CHANGE?

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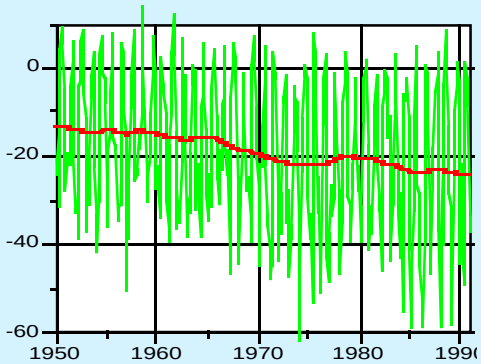
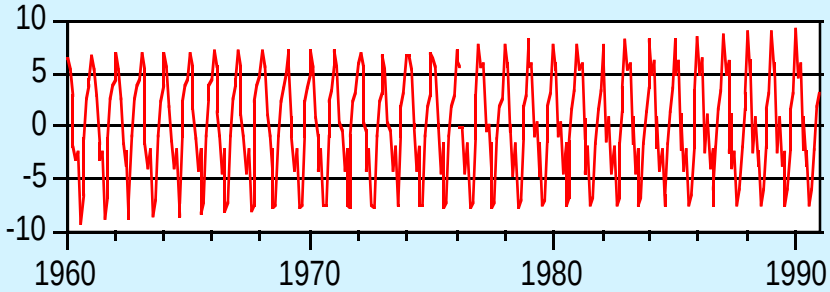
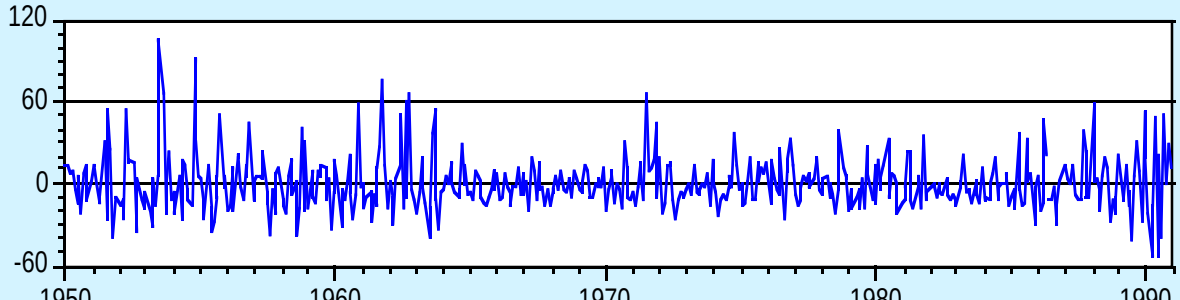
Change in the mean level (trend):



Change in the seasonal cycle:



Change in the variance structure:



STATISTICAL CHARACTERIZATION OF CHANGE

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- TRENDS
  - Global and/or Local variability
  - Long-term trend or change in the seasonal component?
  - Time and frequency domains can both be considered
- NON-STATIONARY SPECTRA
  - Changes in the variance structure through time
- REGIME SHIFTS
  - Tests and modeling of shifts between regimes
  - Hidden Markov Models
- LONG-TERM MEMORY MODELS
  - Persistence of events through time
  - Related to "chaotic dynamics"

DECOMPOSITION OF A TIME SERIES

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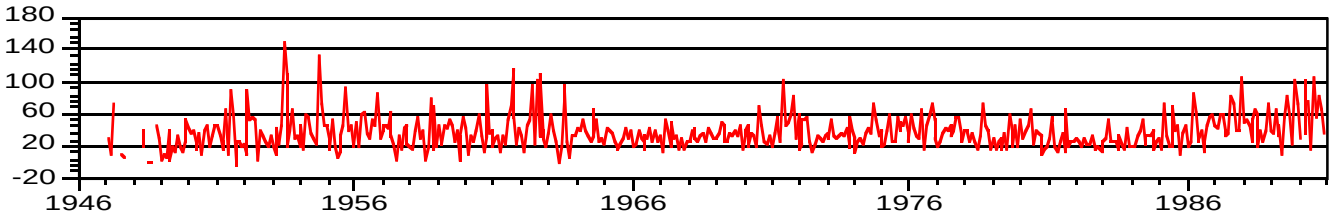
Original Series



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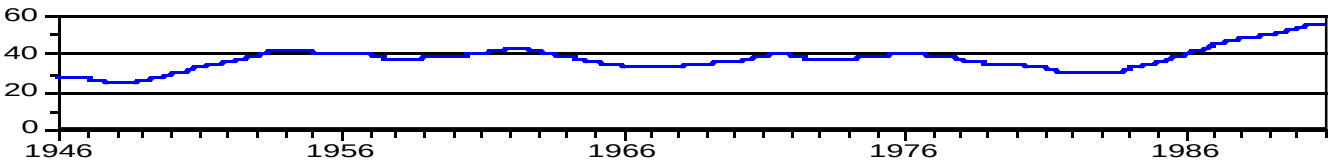
Trend



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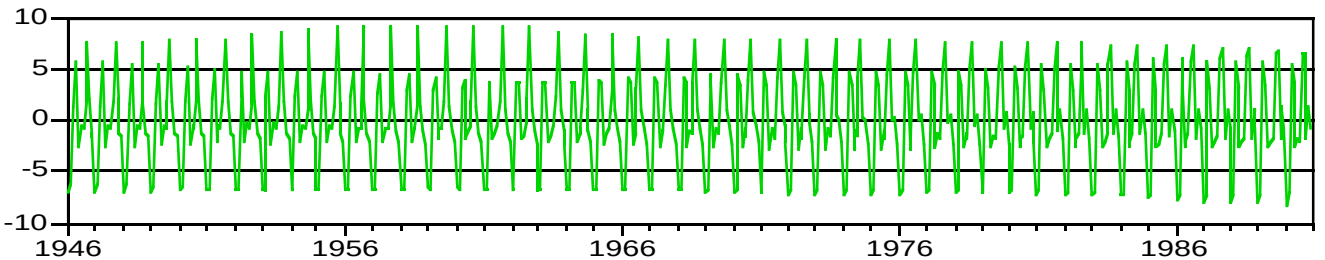
Seasonal



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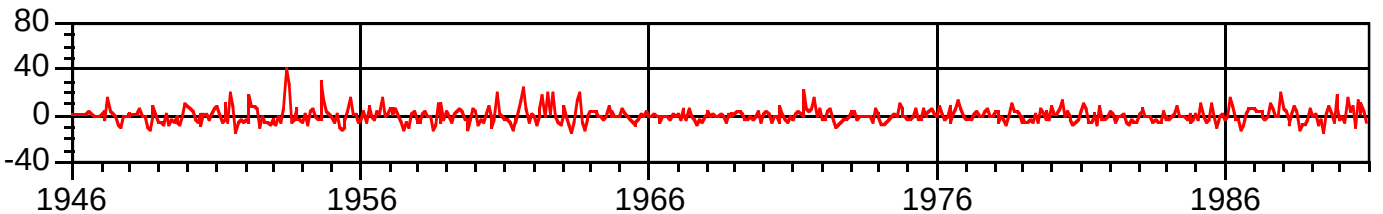
AR



+ ERROR

EXAMPLE: SST OFF CALIFORNIA COAST

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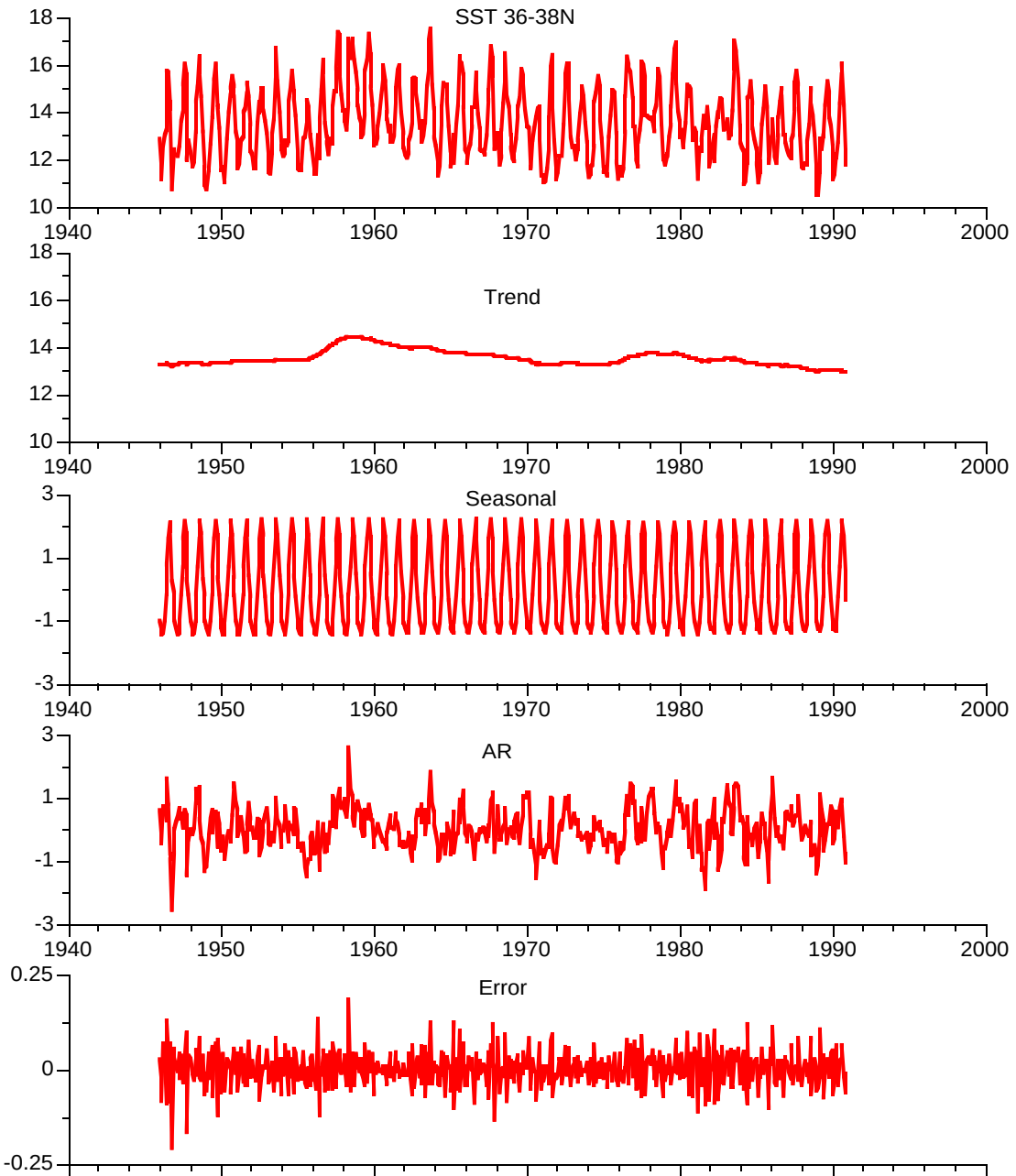

CALCULATION OF TREND

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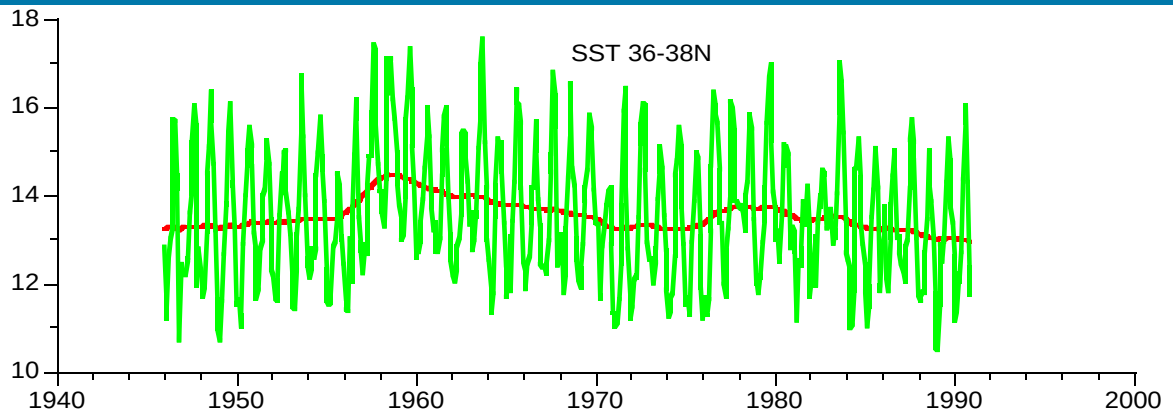

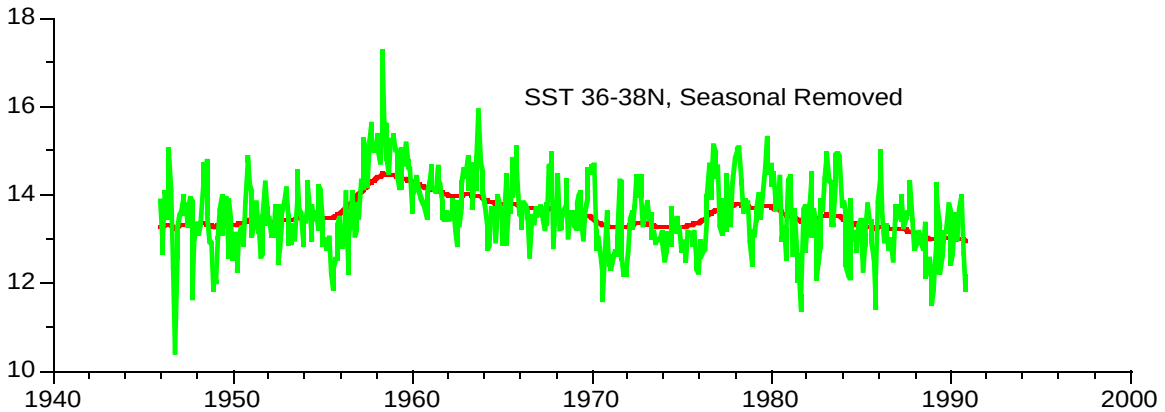

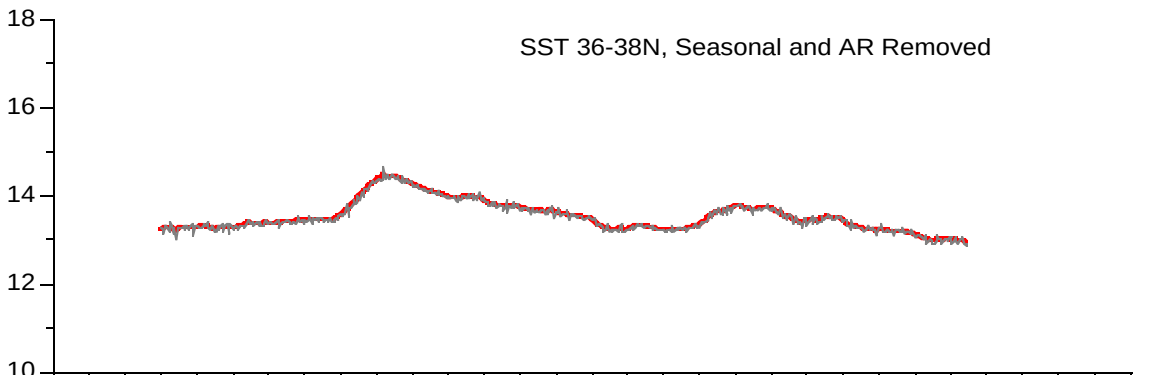

CALCULATION OF SEASONAL

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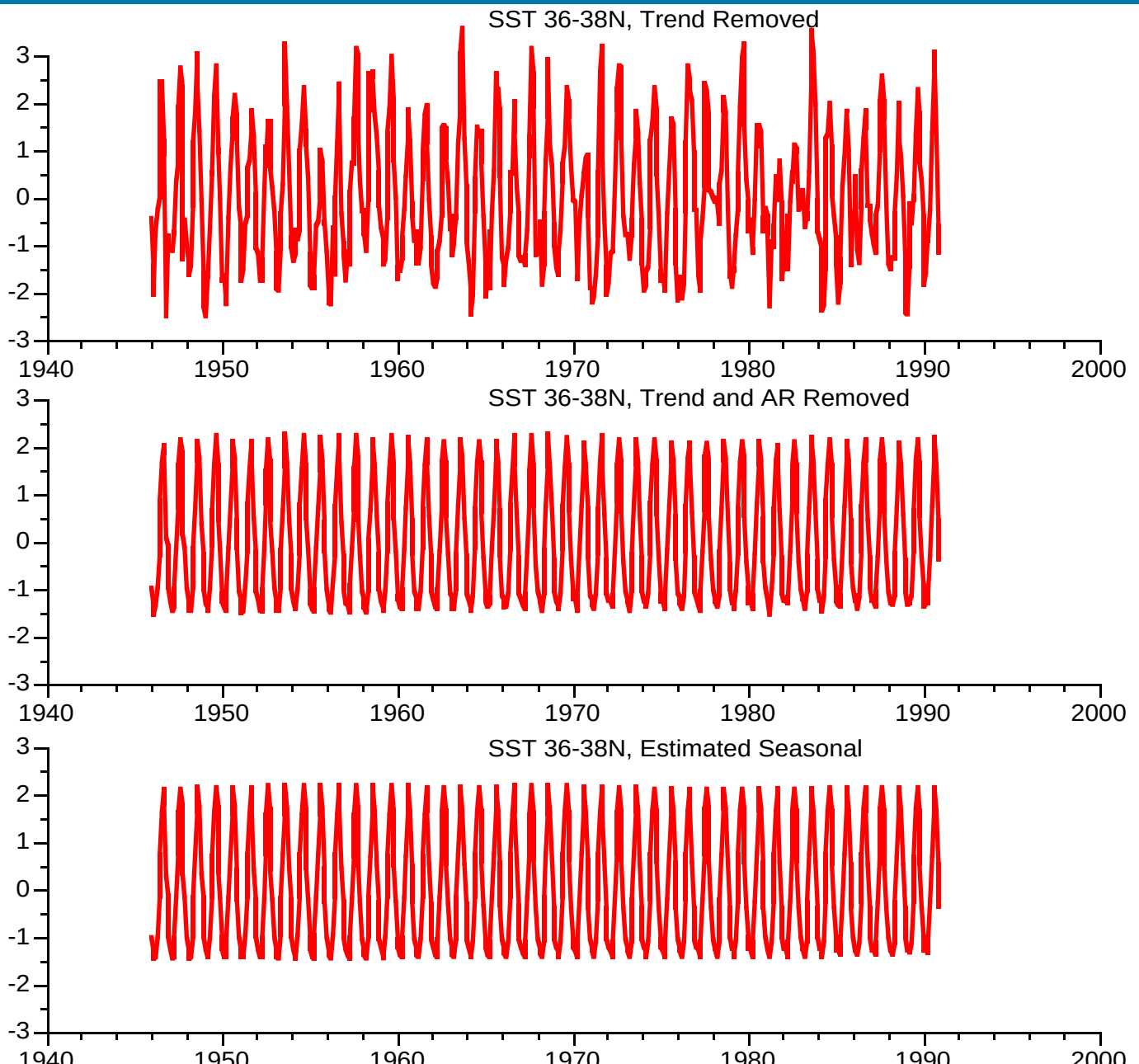

CALCULATION OF SEASONAL (AGAIN)

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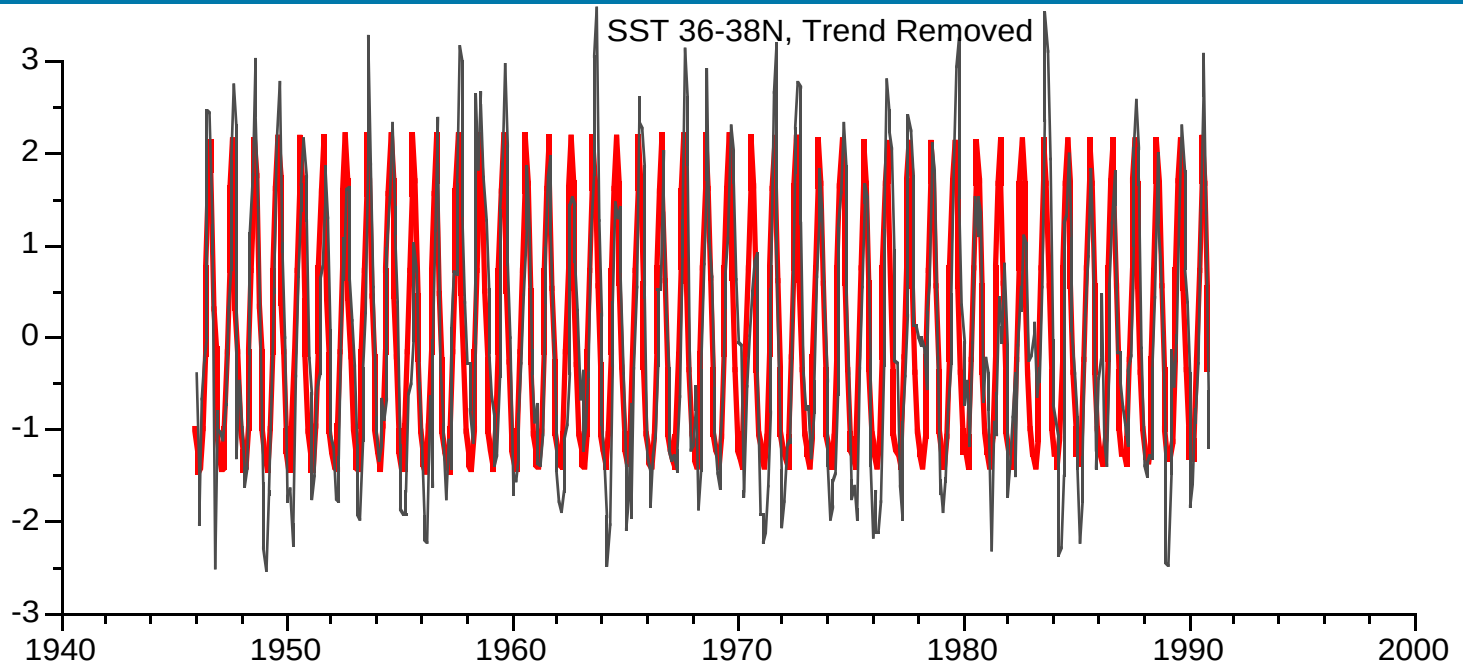

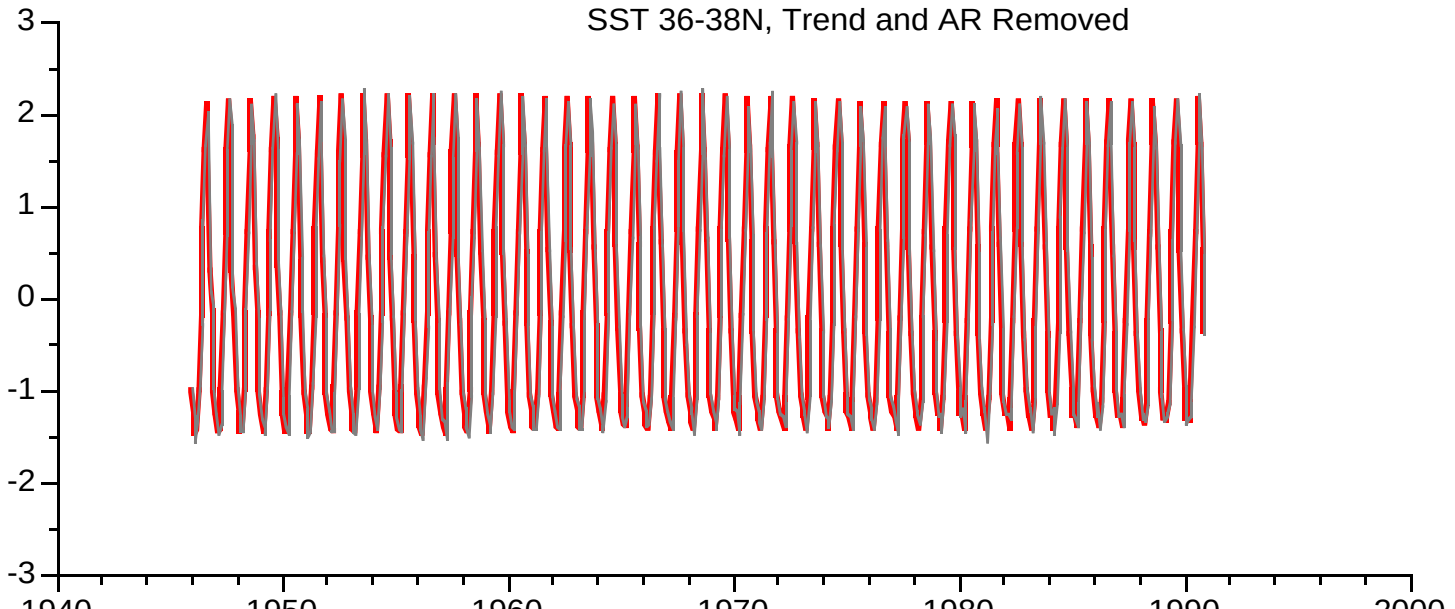

CALCULATION OF AR

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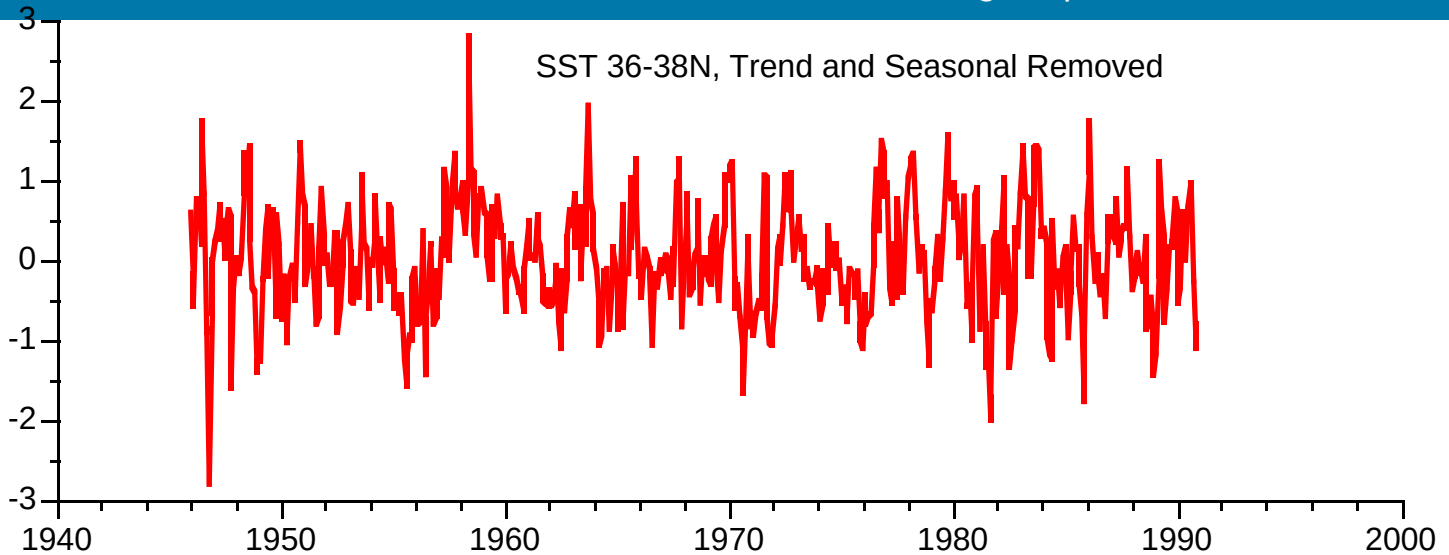

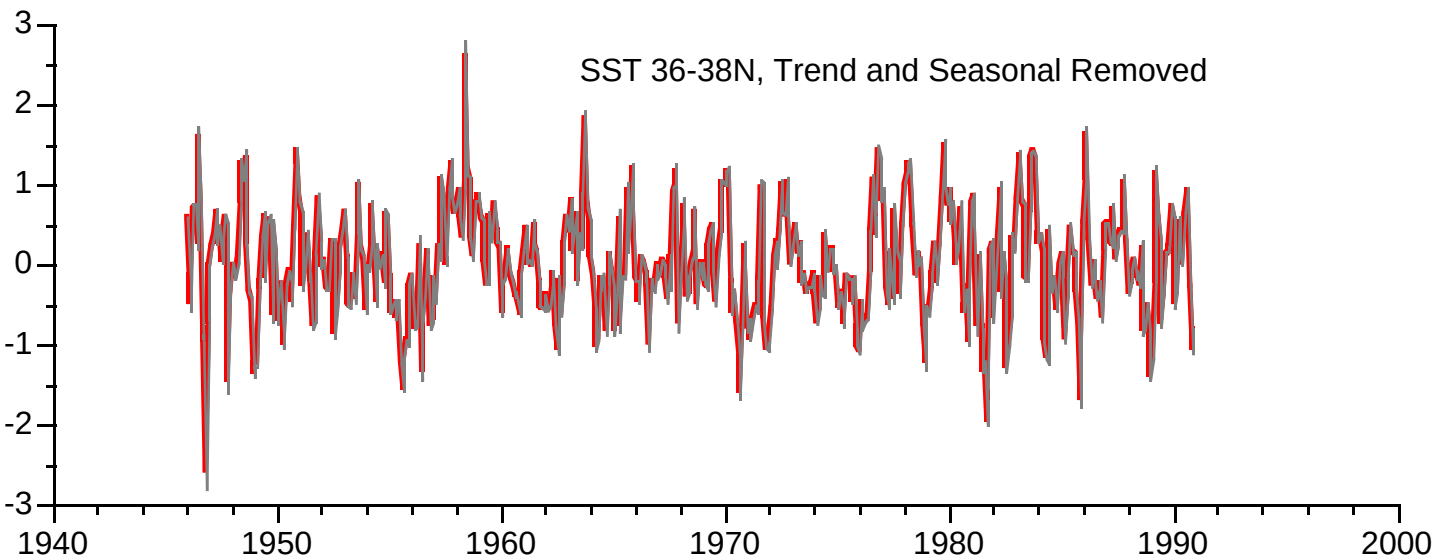

EXAMPLE: N-S WIND STRESS OFF CALIFORNIA

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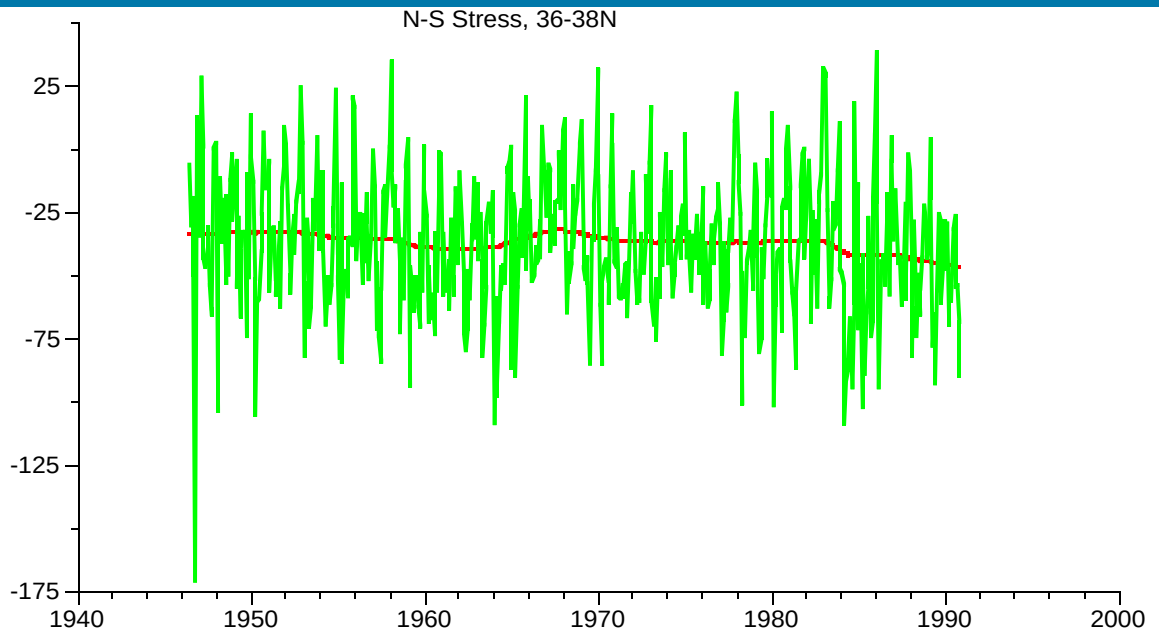

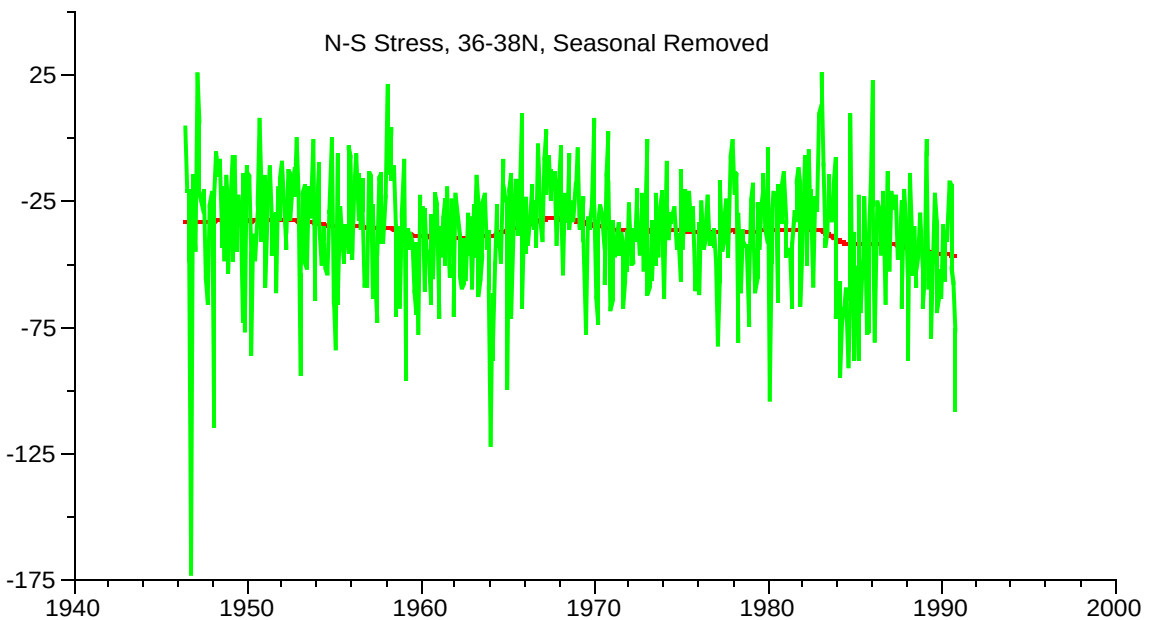

SEASONAL COMPONENT

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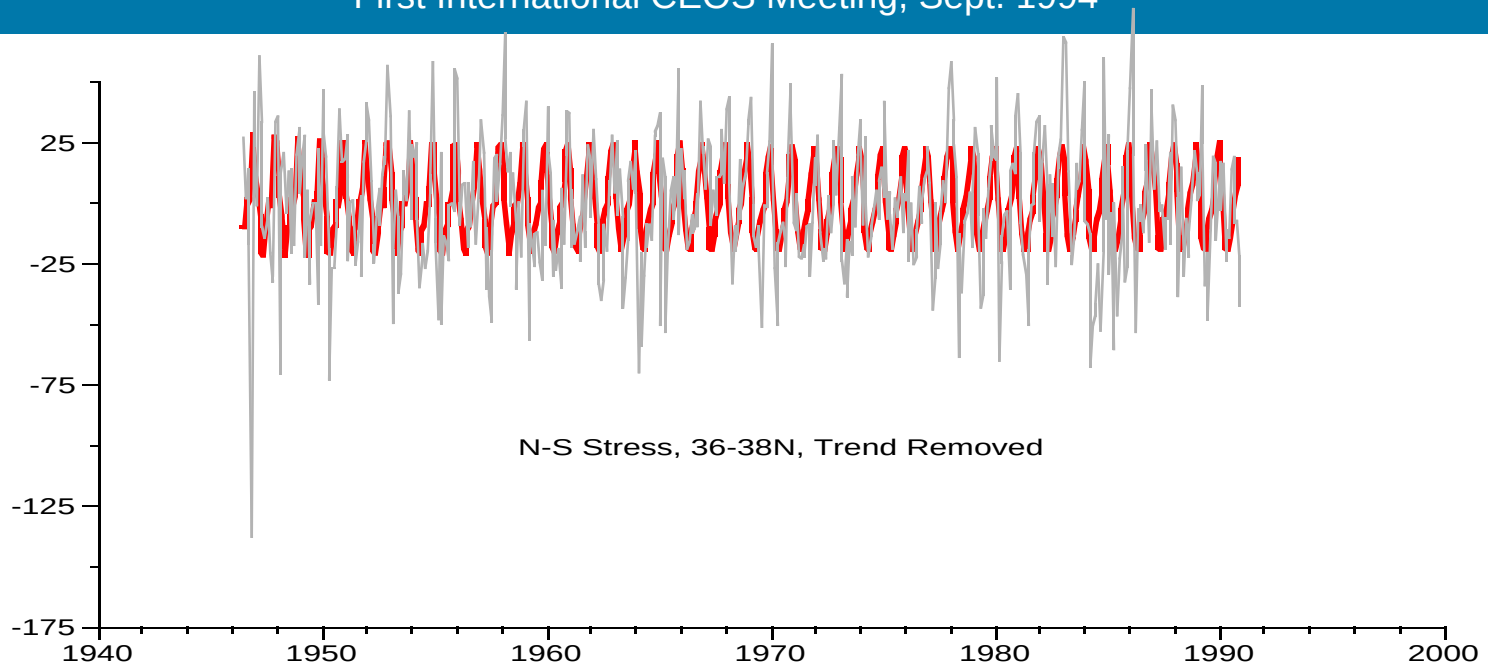

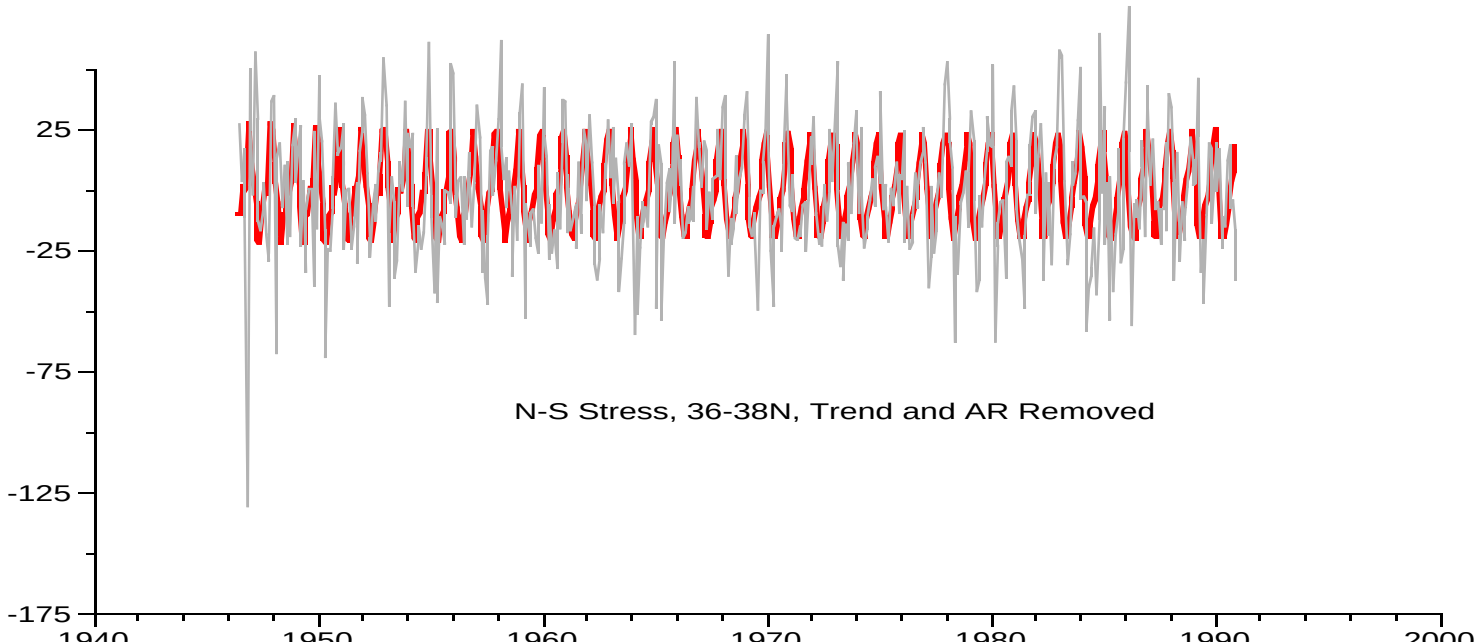

AR AND ERROR SERIES

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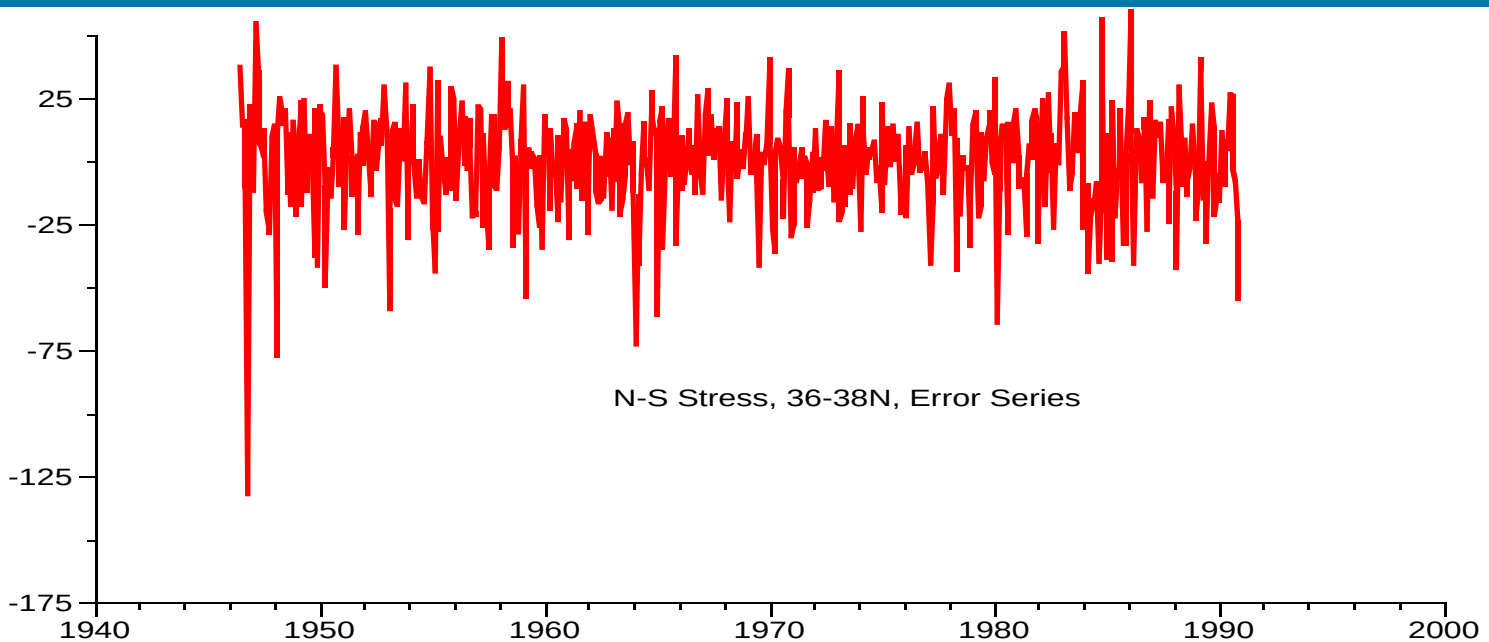

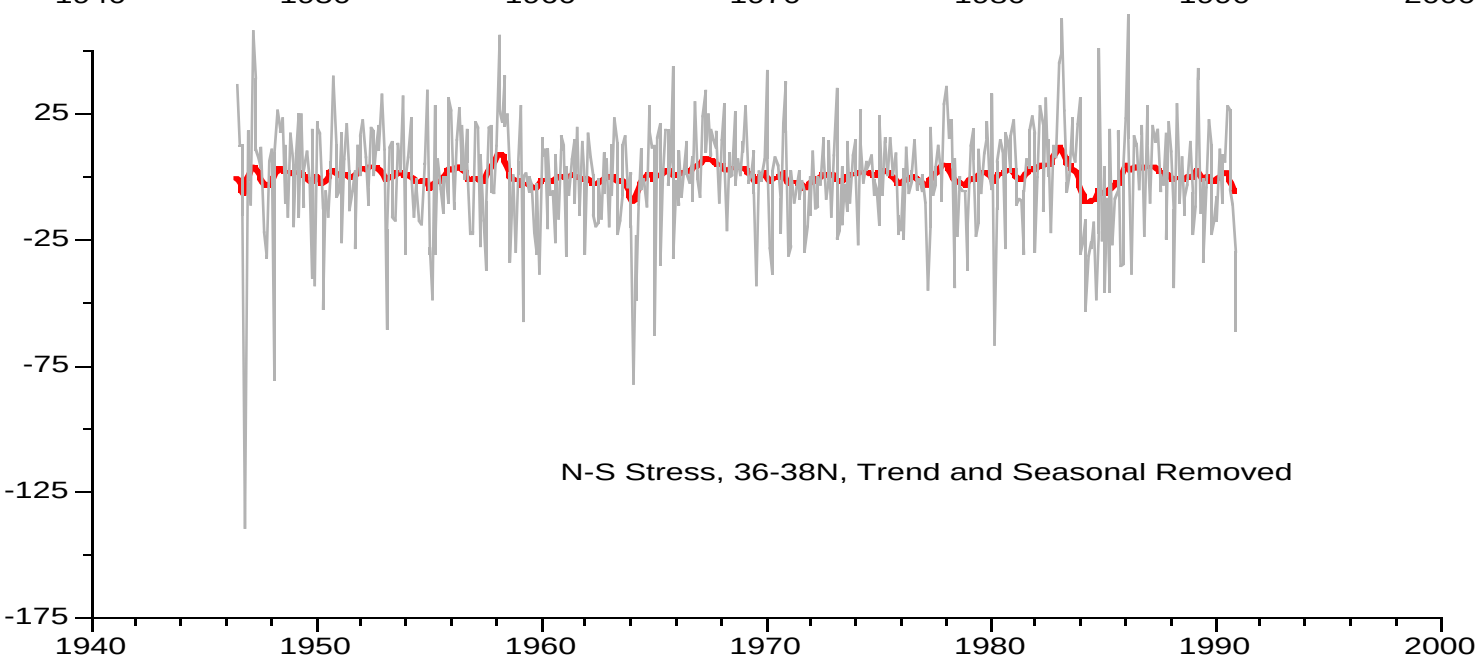

EXTENSIONS OF METHODLOGY

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- Statistical tests of change points, linearity etc.
- Ability to model more exactly abrupt changes
- Multivariate factor model
  - One or more common trends - can differ by affine transformation
  - One or more common seasonals - can differ by affine transformation
  - Can perform analysis of variance type tests for which model is "best" alternative